CHAPTER 6—DESIGN OF THE SCIENCE AND TECHNOLOGY ASSESSMENT

BLUEPRINT

The science and technology framework was based on Maine's *Learning Results*, which identify thirteen **content standards**, as listed below:

- **Classifying life forms:** Students understand that there are similarities within the diversity of all living things.
- **Ecology:** Students understand how living things depend on one another and on non-living aspects of the environment.
- **Cells:** Students understand that cells are the basic units of life.
- **Continuity and change:** Students understand the basis for all life and that all living things change over time.
- **Structure of matter:** Students understand the structure of matter and the changes it can undergo.
- **The Earth:** Students gain knowledge about the Earth and the processes that change it.
- **The universe:** Students gain knowledge about the universe and how humans have learned about it, and the principles upon which it operates.
- **Energy:** Students understand concepts of energy.
- **Motion:** Students understand the motion of objects and how forces can change that motion.
- **Inquiry and problem solving:** Students apply inquiry and problem-solving approaches in science and technology.
- **Scientific reasoning:** Students learn to formulate and justify ideas and to make informed decisions.
- **Communication:** Students communicate effectively in the applications of science and technology.
- **Implications of science and technology:** Students understand the historical, social, economic, environmental, and ethical implications of science and technology.

Nine of these standards (A through I) address the various content areas in science and technology; the remaining four (J, K, L, and M) highlight scientific applications. These have been adapted and combined to create the reporting category framework for science and technology, shown below.

Content Standard	Application			
	J. Inquiry and Problem Solving	K. Scientific Reasoning	L. Communication	M. Implications of Science & Technology
A. Classifying Life Forms				
B. Ecology				
C. Cells				
D. Continuity and Change				
E. Structure of Matter				
F. The Earth				
G. The Universe				
H. Energy				
I. Motion				

All questions in the science and technology assessment measured a content standard; approximately 40% of the questions were written to measure a performance indicator in applications.

CONTENT STANDARDS

The distribution of questions, or emphasis, across standards varied from grade to grade, as shown in the table below.

Content Standard	Grade		
	4	8	11
A. Classifying Life Forms	10%	10%	8%
B. Ecology	12%	10%	10%
C. Cells	10%	15%	12%
D. Continuity and Change	10%	10%	12%
E. Structure of Matter	8%	15%	15%
F. The Earth	10%	10%	15%
G. The Universe	15%	10%	8%
H. Energy	15%	10%	10%
I. Motion	10%	10%	10%

APPLICATIONS

The score for applications refers to a student's use of knowledge and conceptual and procedural understandings as a basis for application through reasoning, inquiry, communication of ideas, and problem solving.

CONTENT SPECS

The MEA science and technology assessment included multiple-choice, short-answer, constructed-response, and extended-response questions. Short-answer questions, which were new in the revised MEA, required students to formulate an answer using one or two words or a short phrase. Extended-response questions in science and technology are similar to constructed-response questions except that they are more complex, requiring 10 to 20 minutes of response time. Each type of question was worth a specific number of points in the student's total science and technology score, as shown below.

Type of Question	Possible Score Points
Multiple Choice	0–1
Short Answer	0–2
Constructed Response	0–4
Extended Response	0–8

The scoring of extended response questions may utilize either two four-point guides, one measuring science content and one measuring science applications, or one eight-point guide, measuring solely content or applications.

TEST DESIGN

The tables below summarize the numbers and types of questions that were used in the MEA science and technology assessment for 1998–1999.

Grade 4									
	Common				Matrix/Pre-test				
Session	MC	SA	CR	ER	MC	SA	CR	ER	Time (minutes)
1	3	0	2	–	2	0	0	–	25
2	3	0	1	–	2	0	1	–	25
3	3	0	1	–	2	1	1	–	27
4	6	3	2	–	2	1	0	–	26
Total	15	3	5	–	8	2	2	–	

Grades 8 and 11									
	Common				Matrix/Pre-test				
Session	MC	SA	CR	ER	MC	SA	CR	ER	Time (minutes)
1	5	1	1	1	2	1	0	0	41
2	5	1	0	0	2	1	1	1	41
3	5	1	2	0	4	0	1	0	41
Total	15	3	3	1	8	2	2	1	

Key

- MC = multiple-choice questions
- SA = short-answer questions
- CR = constructed-response questions
- ER = extended-response questions

The charts on the following pages outline the total number of possible points—as reported—by learning results and item type.

SCIENCE
Number of Points Possible
Grade 4

Standard	Common					Matrix					Total Possible Points
	MC	SA	CR	Points	Percent	MC	SA	CR	Points	Percent	
Content	10	4	16	30	20	78	20	24	122	80	152
Classifying Life Forms (Standard A)	1	0	0	1	6	8	0	8	16	94	17
Ecology (Standard B)	1	0	0	1	5	11	4	4	19	95	20
Cells (Standard C)	1	2	4	7	23	10	6	8	24	77	31
Continuity and Change (Standard D)	0	0	0	0	0	8	0	0	8	100	8
Structure of Matter (Standard E)	2	2	4	8	38	5	4	4	13	62	21
The Earth (Standard F)	2	0	0	2	15	9	2	0	11	85	13
The Universe (Standard G)	1	0	4	5	28	13	0	0	13	72	18
Energy (Standard H)	1	0	4	5	33	6	4	0	10	67	15
Motion (Standard I)	1	0	0	1	11	8	0	0	8	89	9
Application	5	2	4	11	9	50	12	48	110	91	121
Inquiry and Problem Solving (Standard J)	2	2	0	4	11	15	0	16	31	89	35
Scientific Reasoning (Standard K)	2	0	4	6	18	11	8	8	27	82	33
Communication (Standard L)	1	0	0	1	2	16	4	24	44	98	45
Implications of Science and Technology (Standard M)	0	0	0	0	0	8	0	0	8	100	8

SCIENCE
Number of Points Possible
Grade 8

Standard	Common						Matrix						Total Possible Points
	MC	SA	CR	ER	Points	Percent	MC	SA	CR	ER	Points	Percent	
Content	14	6	0	4	24	10	109	22	40	56	227	90	251
Classifying Life Forms (Standard A)	2	0	0	0	2	7	12	2	12	0	26	93	28
Ecology (Standard B)	1	0	0	0	1	4	11	0	4	12	27	96	28
Cells (Standard C)	2	2	0	0	4	14	13	4	0	8	25	86	29
Continuity and Change (Standard D)	2	2	0	0	2	10	13	2	0	4	19	90	21
Structure of Matter (Standard E)	2	2	0	4	6	18	12	4	8	4	28	82	34
The Earth (Standard F)	1	0	0	0	1	4	9	2	8	4	23	96	24
The Universe (Standard G)	1	0	0	0	3	11	12	0	4	8	24	89	27
Energy (Standard H)	1	0	0	0	1	3	13	8	0	8	29	97	30
Motion (Standard I)	2	2	0	0	4	13	14	0	4	8	26	87	30
Application	1	0	12	4	17	13	19	10	24	64	117	87	134
Inquiry and Problem Solving (Standard J)	0	0	0	4	4	8	13	0	12	20	45	92	49
Scientific Reasoning (Standard K)	0	0	4	0	4	14	5	4	4	12	25	86	29
Communication (Standard L)	0	0	4	0	4	27	1	2	4	4	11	73	15
Implications of Science and Technology (Standard M)	1	0	4	0	5	12	0	4	4	28	36	88	41

SCIENCE
Number of Points Possible
Grade 11

Standard	Common						Matrix						Total Possible Points
	MC	SA	CR	ER	Points	Percent	MC	SA	CR	ER	Points	Percent	
Content	11	6	0	8	25	9	111	28	40	80	259	91	284
Classifying Life Forms (Standard A)	2	0	0	0	2	10	8	2	0	8	18	90	20
Ecology (Standard B)	1	0	0	0	1	5	12	4	4	0	20	95	21
Cells (Standard C)	0	0	0	0	0	0	12	2	4	16	34	100	34
Continuity and Change (Standard D)	2	2	0	0	4	10	14	4	4	16	38	90	42
Structure of Matter (Standard E)	2	0	0	0	2	6	16	2	4	8	30	94	32
The Earth (Standard F)	1	0	0	0	1	3	16	4	8	8	36	97	37
The Universe (Standard G)	1	2	0	0	3	11	9	4	4	8	25	89	28
Energy (Standard H)	1	2	0	0	3	8	12	2	4	16	34	92	37
Motion (Standard I)	1	0	0	8	9	27	12	4	8	0	24	73	33
Application	4	0	12	0	16	15	17	4	24	48	93	85	109
Inquiry and Problem Solving (Standard J)	2	0	4	0	6	29	7	0	0	8	15	71	21
Scientific Reasoning (Standard K)	0	0	0	0	0	0	0	2	0	12	14	100	14
Communication (Standard L)	2	0	4	0	6	14	8	0	8	20	36	86	42
Implications of Science and Technology (Standard M)	0	0	4	0	4	13	2	2	16	8	28	87	32